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Earthquake Risks in Canada

Education and Training for C.D.

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Director General: C. R. PATTERSON *Editor:* A. M. STIRTON

ROGER DUHAMEL, F.R.S.C.
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OTTAWA, 1965

"THERE ARE EARTHQUAKE RISKS IN CANADA"

by John H. Hodgson, Dominion Observatory,
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One of the functions of the Emergency Measures Organization involves planning for peacetime disasters. One of the major risks in Canada is the possibility of a major earthquake occurring in one of our metropolitan areas and it is in this connection that the following paper by Dr. Hodgson has been reprinted with the kind permission of the author and "Canadian Consulting Engineer".

Our Technical Planning Division has recently started studies which, in time, should help with the evaluation of the response of buildings to both blast and earthquake induced loadings. It is proposed to continue such studies in cooperation with the National Research Council, Division of Building Research, Canadian universities and any other interested bodies. We are also beginning to participate actively in the work of the National Earthquake Engineering Committee organized by the National Research Council.

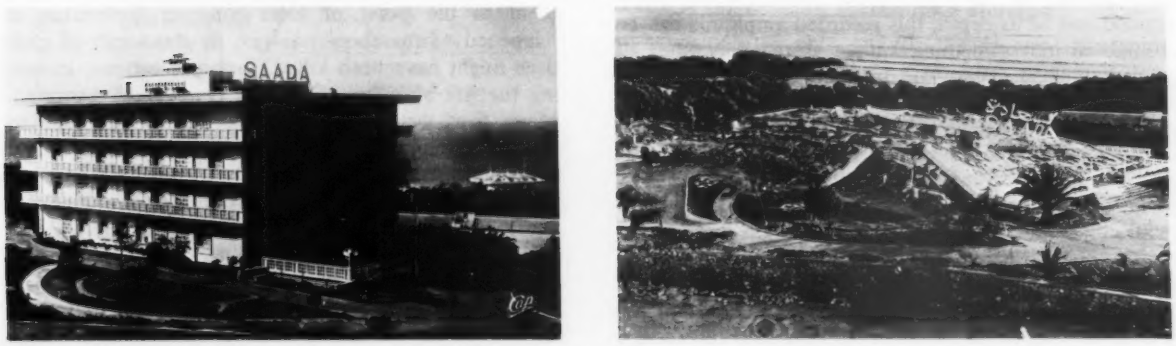

Figure 1. The Saada Hotel, Agadir, Morocco, before (left) and after (right) the earthquake of February 29, 1960. There were no survivors. (Photograph courtesy of the American Iron and Steel Institute.)

EARTHQUAKE ENGINEERING—the design and construction of buildings to resist earthquakes—has been occupying more and more attention of engineers and architects. As a result an International Association for Earthquake Engineering has been founded. Canada is a member of this Association; the adhering organization, the National Committee for Earthquake Engineering, is convened by the Division of Building Research of the National Research Council.

At the first meeting of this National Committee, held late in 1964, it was apparent that some members, appointed because of some special knowledge or skill not directly related to earthquakes, were unaware of the extent of the seismic risk in Canada. The first item on the agenda, therefore, was an outline of these risks. The Committee expressed the view that a similar outline should be made available to the engineering profession in general; that is the purpose of this paper.

It is a fact that despite a number of articles by Canadian seismologists, [1, 2, 3] published in a variety of engineering and underwriting journals, and despite the fact that the National Building Code makes provision for earthquake resistant construction, engineers in general remain blissfully unaware of the extent of earthquake risks in this country. Perhaps it is necessary to shock them. In 1960 the town of Agadir, in North Africa, was almost completely wrecked by an earthquake; 12,500 people were killed and another 12,500 people injured out of a total population of about 30,000. Figure 1 shows a "before and after" view of a modern Agadir hotel; there were no survivors of its collapse. *Since 1925 Canada has had several earthquakes larger than the Agadir one; four were at least 20 times as large and one was 500 times as large. From historical records it is certain that similar earthquakes have existed both on the Pacific Coast and in the St. Lawrence Valley since the beginning of settlement. One of these "historical" earthquakes was apparently under the present city of Montreal; Ottawa may have had an earthquake as large as that of Agadir directly under it and has certainly had larger ones south, east and west*

ABOUT THE AUTHOR

Dr. John H. Hodgson (*Canadian Earthquakes*) is a graduate and former staff member of the University of Toronto. He joined the staff of the Dominion Observatory in 1949, succeeded his father as Chief of the Seismological Division in 1952, and became Director of the Observatories Branch last July, 1964. Dr. Hodgson is currently President of the International Union of Seismology and Physics of the Earth's Interior, and in this capacity has been active in recent years as a UNESCO consultant in Seismology.

of it and many nearly as large north of it; the city of Vancouver has had earthquakes 20 times as large as that of Agadir, north and south of it, and almost certainly east of it.

These facts are shocking but not nearly as shocking as the fact that no major Canadian city has yet enforced the earthquake provisions of the National Building Code.

Earthquake magnitude

Seismologists can speak with authority about the size of modern earthquakes because they have, throughout the world, a large network of precisely calibrated instruments on which to record them. These instruments, called seismographs, permit the measurement of the period and ground amplitude of the wave arriving at any point from an earthquake. By making allowance for the distance of the earthquake from the recording station and of its depth, this recorded amplitude can be translated into something known as the *magnitude* of the earthquake. There will be some slight variation of the magnitude determined at a number of stations but if an average is taken it will be accurate within about a quarter magnitude. Since the world seismological network is sufficiently wide-spread that no earthquakes of damaging intensity can escape detection, we can speak with complete certainty about the location and magnitude of recent earthquakes.

A great deal of effort has been expended by seismologists in trying to determine the relationship between the magnitude of an earthquake and the energy which it releases. The equation currently accepted is:

$$\log E = 11.4 + 1.5M$$

In this equation the energy E is measured in ergs.

If we want to compare the energies E_1 and E_2 of two earthquakes of magnitudes M_1 and M_2 we must write the above equation for each earthquake and subtract to obtain

$$\log E_1/E_2 = 1.5\ (M_1 - M_2)$$

This equation will give us the ratio of energies in any two earthquakes.

We are going to use this equation to compare the energy released in Canadian earthquakes with that of a "standard" earthquake. I might choose as a standard the Agadir earthquake mentioned earlier, but that would give a distorted picture since building standards in North Africa are not comparable with those in Canada and since that earthquake was very shallow. Instead I am going to choose one which struck Long Beach, California, in 1933; this choice is a fair one because that earthquake had a depth comparable to that of Canadian ones, because the soil conditions were no worse than in most Canadian areas, and because Long Beach was a North American city with living conditions and building standards not markedly different from those in Canada.

The Long Beach earthquake did $50 million worth of damage. It damaged every school in the city, some of them to the point of total collapse; fortunately it happened when school was out, or thousands of children might have been killed. Communications, including the fire alarm system, were completely disrupted. Many fires were started by the earthquake, due to short-circuiting of wires, and the firemen had to be led from one fire to the next by Boy Scouts. At that the firemen were lucky; all the fire stations were wrecked, but they were able to save their equipment and no important water mains were broken.

The Long Beach earthquake had a magnitude of 6.2. If we put M_2 equal to 6.2 and E_2 equal to unity, the foregoing equation will tell us the ratio of the energy released in any other earthquake to that of the Long Beach one. The graph of this equation is shown in Figure 3; magnitudes have been indicated on the horizontal axis, the energy ratio with respect to the Long Beach earthquake along the vertical one. Two general points have been indicated on the graph—the threshold of damage, provided by an earthquake of magnitude 5, and the largest known earthquake, of magnitude 8.9. We see that the former has only about 1/100th the energy of the Long Beach earthquake, the

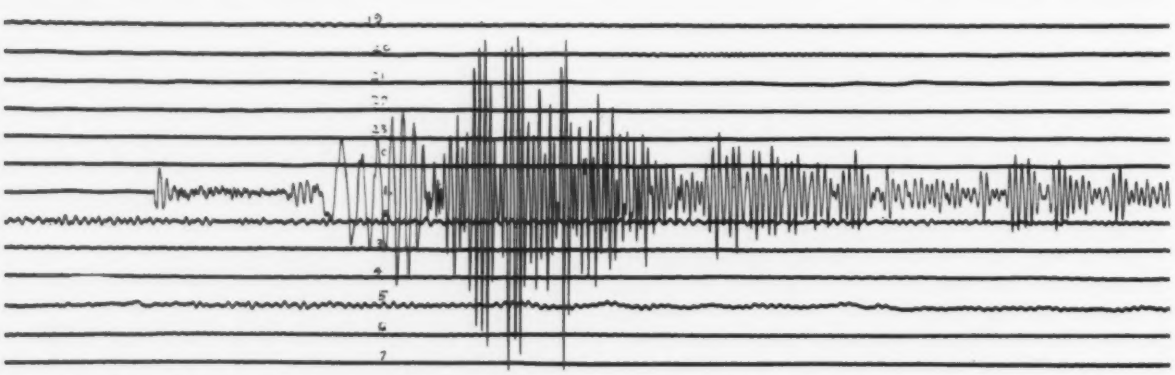

Figure 2. The record produced in Ottawa by one of the smaller aftershocks of the Alaskan earthquake of March, 1964. (Movement in the main shock was so violent that the trace could not read.) From records such as this it is possible to determine the magnitude of the earthquake, a measure of its exact size.

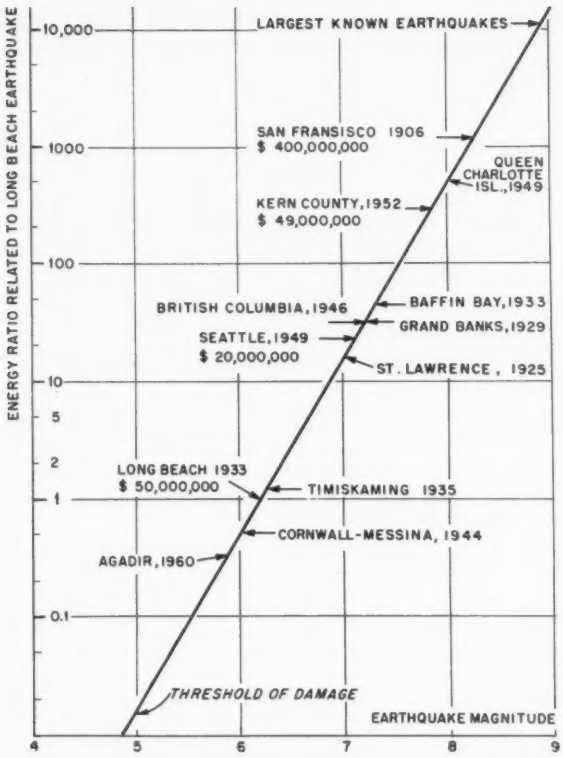

Figure 3. Energy v magnitude, as factors of energy released in Long Beach earthquake. It will be seen that several Canadian earthquakes released between 20 and 50 times as much energy as this $50,000,000 shock.

latter more than 10,000 times as much. This emphasizes the fact that the magnitude scale, being a logarithmic one, is very compressed.

The position of the larger recent Canadian earthquakes has been shown and, for comparison purposes, a number of better known earthquakes which have caused large amounts of damage have also been indicated. The statements made earlier about the relative size of Canadian earthquakes is borne out; it should be stressed that there is no guess work involved—all the earthquakes have been recorded by well-calibrated seismographs and there can be no question about their magnitude. Unfortunately, this claim can only be made since about the turn of the century. We must, for earlier times, depend on the historical records and even these are very limited. The span of human habitation in North America is infinitesimal when viewed against the geological time scale.

Our knowledge of earthquakes in historic times is derived from the studies of three members of the Dominion Observatory staff—E. A. Hodgson,[3-7] former Chief of the Seismological Division, W. E. T. Smith[8-11] who has published a number of papers on earthquakes of eastern Canada, and W. G. Milne[12-19] who has concentrated on studies of western Canadian earthquakes. The details of the history may be found in their papers but a list of larger earthquakes (*see* page 4) will be of interest here. In this list magnitudes have been assigned to the earthquakes by comparing the damage described in historical texts with that known to have occurred in recent earthquakes. This comparison allows some estimate of magnitudes but it must be admitted these estimates do not have the accuracy of those given for the earthquake shown in Figure 3.

The list should establish beyond question that Canada does have serious earthquakes. The question must then be answered "why have we had so little damage from them"? I submit that it is purely a matter of luck. We didn't happen to have cities where the earthquakes struck at the time they struck.

Factors influencing earthquake damage

Magnitude is only one of the factors influencing earthquake damage. This is clear from an examination of Figure 3. The Long Beach earthquake had a magnitude of 6.2, it caused $50 million worth of damage and killed 120 people; the Agadir earthquake with a magnitude of only 5.9 killed 12,500 people and almost completely wrecked the city. What are the other factors?

The first is the *depth* of the earthquake. In most earthquakes the energy may be supposed to be released from a point or a relatively small volume. This point is called the *focus* (the point on the surface directly above the focus is called the *epicentre*) and the focus is almost never on the surface. The depth can vary from a few miles to more than 400 miles. Obviously, if an earthquake focus lies deep within the earth no point on the surface is very close to it, but a large area is about equidistant from it. Deep focus earthquakes, therefore, are felt over a wide area but the intensity is nowhere severe. On the other hand, if the focus is very shallow the surface immediately above it is very close to the point of energy release, but the damage should drop off very rapidly as we go away from this point. This factor was one of the most serious in the case of the Agadir earthquake. The focus was only two miles deep and lay immediately under the city; damage was slight five miles away from the epicentre, but unfortunately the entire city lay within this radius.

The question of the depth of focus of Canadian earthquakes has not been yet completely solved. Earthquakes in western Canada seem to be very much like those in California but eastern Canadian earthquakes are felt, as has been indicated in the table, to very large distances. For this reason it was believed for many years that they were deeper than normal. If true this would be good news, for we might expect them to be much less damaging than normal for a given magnitude. Unfortunately, all recent studies, made by several different seismologists, have pointed in the same direction —that the focal depth of eastern Canadian earthquakes is about ten miles. This is very nearly the same as for

California earthquakes and this is why the Long Beach earthquake may be regarded as a fair basis for comparison with our own.

Why then should eastern Canadian earthquakes be felt to such distances? It appears to be related to the nature of the crust in the Canadian Shield, and it is a matter for continuing research. Whatever the cause, the implications are serious for earthquake engineers. As seismic waves are propagated to increasing distance the short period waves tend to be attenuated, but the longer ones, in the 1-3 second range are carried with relatively little loss. The fundamental period of many buildings lies in this range. Thus, waves potentially destructive to large numbers of buildings, may be expected to propagate to great distances in eastern Canada. Some instances of this can be given by experience. The 1925 earthquake did considerable damage in Quebec, Three Rivers and Shawinigan Falls, at distances up to 200 miles, and it did some minor damage to buildings as far away as Ottawa.

Here are our larger earthquakes

Date	*Location*	*Estimated magnitude*
Eastern Canada		
1638	**St Lawrence River near the mouth of the Saguenay**	**7**
	This earthquake was felt widely over eastern Canada and the New England States.	
1663	**Near the mouth of the Saguenay**	**7.5-8**
	This earthquake was felt generally over eastern North America and resulted in great alarm and a religious revival in the New England States. Landslides occurred over all of the then-known water-shed of the St. Lawrence River causing the rivers to run muddy for several months. A waterfall on the St. Maurice River disappeared.	
1665	**In the same location as the above**	**6.4**
1732	**At Montreal**	**7**
	Three hundred houses were damaged and one child was killed.	
1791	**St Lawrence River near the mouth of the Saguenay**	**6.4**
1816	**Near Montreal the Saguenay**	**5.5-6**
1831	**Two earthquakes, of about equal intensity occurred near the mouth of the Saguenay during this year**	**5.5-6**
1855	**Centered near Moncton, N.B.**	**5.5-6**
	Felt as far east as Montreal.	
1860	**Mouth of the Saguenay**	**6.5-7**
	This earthquake was felt as far west as Hamilton, and as far south as Newark; the felt area exceeded 700,000 square miles.	
1861	**At Ottawa**	**5.5-6**
	Many chimneys were overturned.	
1870	**St. Lawrence River near the mouth of the Saguenay**	**7**
	Almost all of the brick or masonry structures in the epicentral area of the earthquake were destroyed.	
1897	**Near Montreal (two earthquakes)**	**5.6**
1914	**Near Lanark, Ontario**	**5.6**
1924	**On the Ottawa River, between Arnprior, Ontario and Quyon, Quebec**	**6.1**
1925	**St. Lawrence River near the mouth of the Saguenay**[3,4]	**7**
	This earthquake was felt as far west as the Mississippi, as far south as Virginia, and as far north as there was anyone to feel it. In the immediate epicentral area all chimneys were destroyed and most stone buildings were damaged beyond repair. Considerable damage was caused at Quebec, Three Rivers and Shawinigan Falls, at distances of up to 200 miles from the centre of the earthquake.	
1929	**Grand Banks, Nfld.**	**7.2**
	This earthquake broke 12 trans-Atlantic cables in a total of 28 places and set up a seismic sea-wave which drowned 27 people.	
1933	**Baffin Bay**	**7.3**
1935	**Timiskaming, Que.**	**6.2**
	This earthquake occurred almost immediately under the very well-built company town of Timiskaming and damage there was not severe. However, chimneys were knocked down at Matawa and at North Bay, some 40 miles from the centre of the shock and it was felt all over eastern Canada and as far west as Duluth.[5]	
1944	**Cornwall, Ont.**	**5.9**
	The epicentre was under the St. Lawrence River, midway between Cornwall, Ont., and Massena, New York.	
	The estimate of damage from this earthquake in the two cities ranged to $2,000,000.[6]	
Western Canada		
	In western Canada our historical records go back a much shorter time and the first earthquake that Milne's studies have disclosed was a minor one occurring in 1841. The large earthquakes may be listed as follows:	
1872	**An earthquake was felt over all inhabited parts of British Columbia**	**7.5**
	Milne has weighed the evidence very carefully and has concluded that the centre of this earthquake must have been near to the international border and east of Vancouver. This is a very serious conclusion since it indicates that large earthquakes may occur inland from Vancouver.	
1918	**Near Estevan, on Vancouver Island**	**7**
1929	**Queen Charlotte Sound**	**7**
1944	**Whitehorse, NWT**	**6.5**
1946	**Strait of Georgia between Powell River and Courtenay, B.C.**	**7.3**
	This earthquake did a great deal of damage both to man-made structures and to the ground. A complete description has been given elsewhere[7] (see figure 5).	
1949	**Northern tip of Queen Charlotte Islands**	**8.0**
	Because of its location in an area still only slightly inhabited damage from this earthquake was minor.	
1952	**South of Whitehorse, NWT**	**6**
1953	**East central Yukon**	**6.5**
1955	**East central Yukon**	**6.5**

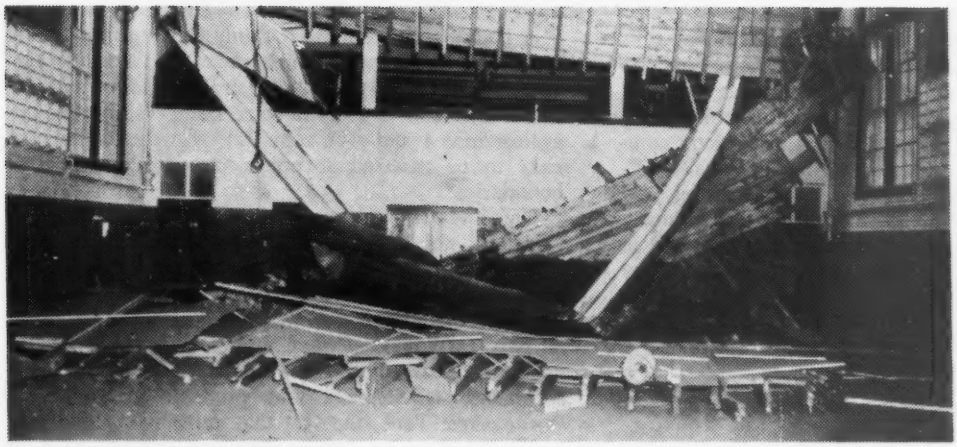

Figure 4. Collapse of roof in Cornwall high school, earthquake of Sept. 5, 1944.

Another factor which clearly influences the distribution and extent of damage is the *nature of the soil.* In the San Francisco earthquake it was found that if damage on the most solid rock was taken as unity, then damage on made land ranged from 4.4 to 11.6, on loose sand from 2.4 to 4.4, and on sandstone from 1 to 2.4. This same pattern is observed in most earthquakes and has been particularly true for those in eastern Canada. The damage on the thick marine clays which covers so much of the St Lawrence and Ottawa valley has always been very much more marked than on the adjacent outcrops of rock. It should be mentioned, however, that in recent years earthquake engineers are coming to question the blanket assertion that unconsolidated soil must be dangerous. They feel that poor soil need not necessarily make for a dangerous building condition provided it is accounted for in the design.

It seems probable that two of the factors, anomalous distance of propagation and poor soil conditions, may operate in a particular way in eastern Canada.[21] A large part of the St Lawrence and Ottawa watersheds have thick deposits of marine clays which are subject to landslides under favorable ground-water conditions. There is ample evidence that landslides may be triggered by earthquakes. If a large earthquake were to occur at the right time of year it seems almost certain that landslides would occur more or less simultaneously over large parts of eastern Canada. The damage which occurred in the earthquake of 1663 was probably caused almost completely by landslides. The contemporary accounts can only be interpreted in this way:

> New lakes are seen where none was before. Some mountains were engulfed and disappeared. Many a waterfall is levelled and many a river is no more. The ground cracked in many places and opened crevices of unmeasured depth. And there has resulted such a disorder of fallen and splintered trees that one sees today fields of more than a thousand arpents all levelled as if they had been recently tilled, in many places where there was nothing but forest.

There is a more modern example of this effect: the Timiskaming earthquake of 1935 caused a landslide at Parent, Quebec, a distance of 200 miles from the epicentre. It seems very clear that under favourable conditions this sort of damage might be extremely widespread and I leave it to the engineers who know the construction practices in the St. Lawrence valley to judge how serious it might be.

A final factor in the extent of damage is, of course, the *nature of buildings,* the care with which they have been designed, and the degree of supervision that has gone into their construction. This is a matter for the earthquake engineer and it is beyond the scope of this paper to describe this matter in detail.

Figure 5. The chimney of Courtenay elementary school collapsed into the interior of the building in 1946 earthquake.

The factors then that influence damage are: the magnitude and depth of focus of the earthquake, its nearness to built-up areas, the nature of the soil and the nature of the buildings. It is now clear that the Long Beach earthquake provided a reasonable comparison with Canadian ones. The magnitudes are strictly comparable, the building standards are not drastically different than those in force in many Canadian cities, and the nature of soil conditions are no better than in many parts of Canada. The sort of damage that occurred in Long Beach must, therefore, be expected in any Canadian city which is in a seismic zone. What are the seismic zones?

Seismic probability map

When the first edition of the National Building Code was being prepared in 1953 it was desired to include provisions for earthquake risk. This made it necessary that a map be prepared defining areas of risk; a copy of this map is given as Figure 7. The map was based on a scale established originally in the United States which divided the country into four zones 0, 1, 2 and 3, corresponding to zones of anticipated zero, minor, moderate or major damage. Zone 3 assigned to the coast of British Columbia and to the St Lawrence-Ottawa watershed, was the same rating given to the more seismic areas of California. Engineers were not very happy with the map, not only because they found it difficult to accept the high rating, but because the boundaries between zones were straight lines or smooth curves with zone 3 areas in some instances abutting up against zone 1 and even zone 0. How were earthquake risks to be assessed at points close to one of the boundaries.

Unfortunately, the format of the National Building Code did not allow for the publication of any text stating the limitations of the map (although such an article was published elsewhere[2]). These limitations can be simply stated; the map was based on what we knew of past earthquakes, what was known about earthquakes in areas adjacent to Canada, and what geological theory suggested about the probable occurrence of earthquakes. Thus, the fact that earthquakes had occurred in Montana, immediately south of the border, suggested that earthquakes were a possibility in Alberta and eastern British Columbia; the fact that earthquakes occur everywhere around the boundary of the Pacific suggested that, even if there had been no known earthquakes in the coastal areas of British Columbia, it must have been regarded with suspicion; the Canadian Shield is regarded by geologists as a stable area and was therefore placed in zone 0. The very general form of the boundaries was intended to imply that they were not

Figure 6. Landslide at Hope, B.C. which resulted in four deaths. This slide was apparently triggered by an earthquake. (Photograph courtesy of Brian Jones, Trans-Mountain Oil Pipe Line Company.)

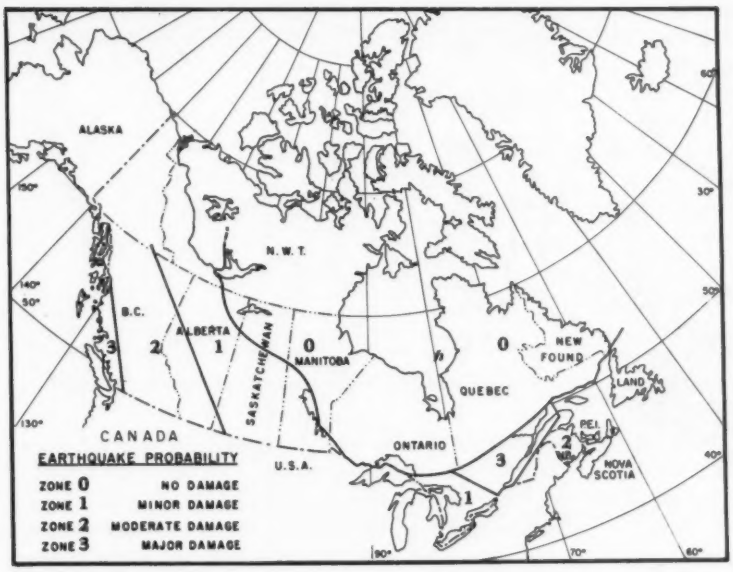

Figure 7. The 1952 version of earthquake probability map for Canada.

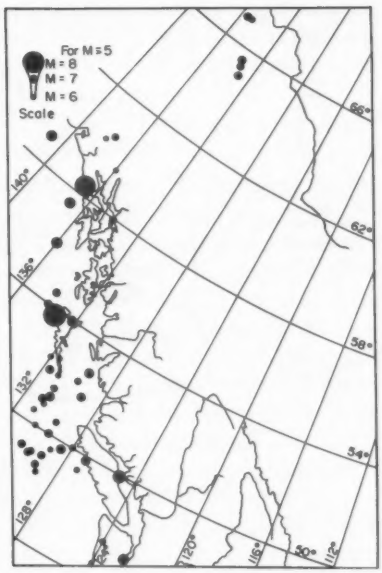

Figure 8. Earthquakes in Western Canada, 1900-1960.

well-defined. No one suggested that the map was in any sense final; it was simply the best that could be done at the time.

There was a good deal of opposition, both to the inclusion of earthquake risks in the Building Code and to the lack of detail in the map. Engineers suggested that a more useful map would be one which showed the occurrences of all past earthquakes. The Seismological Division began the preparation of such maps and this work is now nearing completion. Maps are available for British Columbia (see Figure 8) and for the Arctic. Maps are available covering the record in eastern Canada to the end of 1927 (Figure 9) and for 1954-1962 (Figure 10) and the remaining years are being covered as rapidly as possible. We have been glad to provide these maps but, while they are extremely important, they must not be regarded as seismic probability maps. Written history in eastern Canada dates back only some 400 years, in western Canada scarcely more than a hundred, and in Arctic Canada not much more than a quarter of a century. These periods are so very short in geological times that there might be areas of major seismic risk in Canada of which we are completely unaware. (The city of Agadir, mentioned earlier, had been destroyed by an earthquake 200 years ago and this fact had been completely lost track of.) The most that we can say from the maps is that earthquakes have occurred in certain areas and are likely to occur there again. We must use these maps as part of our total information but we must not regard them as the last word.

W. G. Milne is currently producing a map, based on past history, but more sophisticated than the simple epicentral maps. It is based on a computer analysis of a punch-card catalogue of past earthquakes and will show the amplitude of the vibration which any point would have suffered in the historic period either due to nearby earthquakes, large or small, or to large distant ones. The effect of the latter will, as we have seen, vary from one part of the country to the next and a factor will be placed into the computer to take account of this. The computer will be supplied with cards giving the location and magnitudes of all earthquakes, not only those in Canada, but also those close enough to the border, in Alaska, Greenland or the United States, to have had some effect in Canada. For any point considered, the computer will sum the effects of past earthquakes from all sources. To produce a map, we simply ask the computer to sum the values for enough points to permit contouring. The strength of the method is, that as additional earthquakes occur, the cards are entered into the file and one can re-appraise the past history at any point, simply by asking the computer to re-determine the value. In this way an engineer with an interest in a particular area can be given the most up-to-date information with a minimum of delay. The map itself can be re-computed and re-issued as the number of earthquakes demand.

Seismic regionalization

These new maps, important as they will be, still suffer from the limitation of our short history. Seismologists within the Soviet Union have pioneered in the production of "seismic regionalization maps" which attempt to overcome the brevity of our historical knowledge by making use of other information.

Figure 11 shows a map of known earthquakes in the United States. In California there is a great cluster of

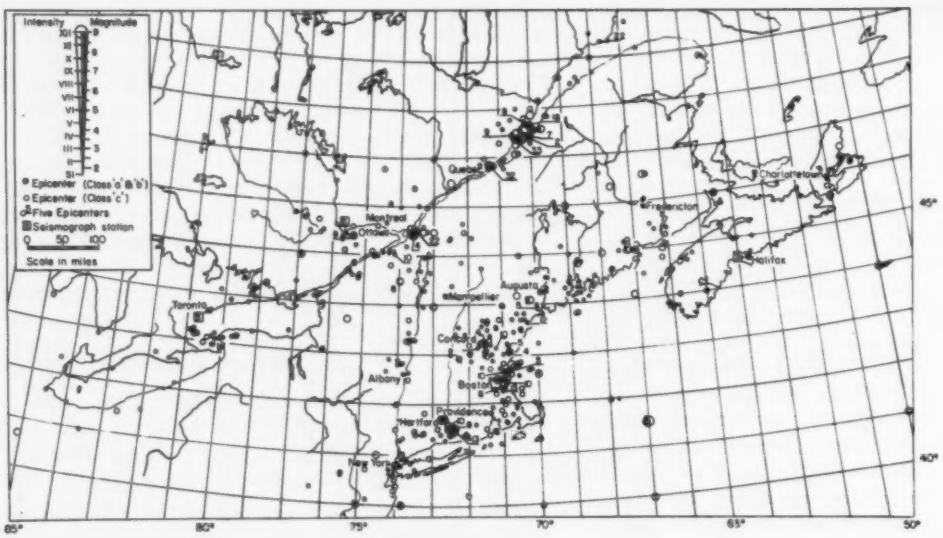

Figure 9. Earthquakes in Eastern Canada 1534-1927.

dots along the Pacific coast. These dots are controlled by a system of faults of which the principal one is the famous San Andreas. These faults can be clearly seen on the surface, there is no question that the earthquakes are associated with them, and we readily recognize a connected system. The principle of seismic regionalization is, that when such a unit is recognized, an earthquake must be expected anywhere along that line as large as the largest ever known to have occurred. In the case of the San Andreas fault system, which was responsible for the San Francisco earthquake of 1906, we must suppose that an earthquake of magnitude 8 might occur anywhere along the line. Engineers may feel that to assign the largest magnitude to any point rather than an average one is unnecessarily restrictive. On the contrary, it is probably not restrictive enough; larger earthquakes than any known have almost certainly happened in the pre-historic past.

If you examine Figure 11 you will probably see the suggestion of other alignments of earthquakes. For example, there is an alignment running northward from the centre of Arizona to the centre of Montana. Is this a tectonic line? Must we assign an earthquake equal to the largest recorded one to any point on that line? It is a little difficult to say because there is no well-marked fault system in this instance. Another line which has suggested itself to many people is that obtained by producing the line of the St. Lawrence River and Great Lakes down into the United States through Ohio, Indiana and Kentucky. There are a large number of earthquakes on this line and if one includes smaller earthquakes than those plotted in Figure 11 the evidence for the line is still more striking. The implications of this are very serious. In 1911-12 a series of earthquakes occurred in New Madrid, Missouri, greater than any other known United States earthquakes. They occurred so long ago that we can only guess at their magnitude but it was certainly something in excess of 8. If we admit the existence of the St. Lawrence-Great Lakes-Missouri line, then we must expect that an earthquake of magnitude 8 might occur anywhere along that line.

We are not prepared to suggest that any such line exists, only that earthquake epicentres suggest it. The principle of seismic regionalization is to bring as much additional information as possible to bear on the significance of suspected lines. Do land forms suggest rapid rising in recent geological times, is there any unusual uplift or lateral displacement of geological strata, do geophysical measurements suggest any structural discontinuity, does geodetic or precise levelling control show current movement? All such evidence is sifted to define active lines. Once a line has been established and the largest earthquake on it discovered the effect of such an earthquake at any point on the line is evaluated for the whole region. The rate at which energy drops off

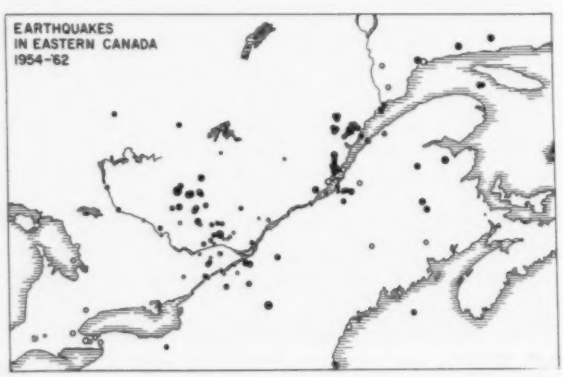

Figure 10. Earthquakes in Eastern Canada, 1954-1962.

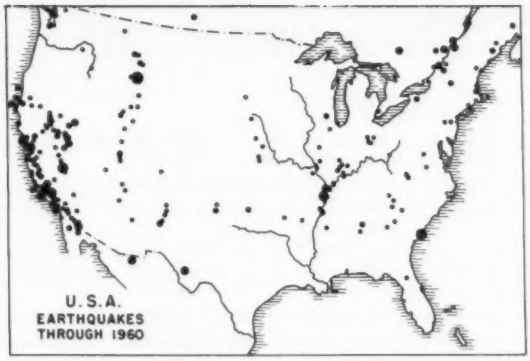

Figure 11. United States earthquakes to the end of 1960.

with distance is considered, the effects of soil are allowed for, and a map is produced showing the amplitude of the seismic waves which may be expected at any point. Even more refined maps are prepared for some parts of the Soviet Union. They take account of the frequency of earthquakes and give the amplitude which may be expected within 10, 100, or 1,000 years. Such maps, of course, are far beyond the scope of our present knowledge in Canada.

The Department of Mines and Technical Surveys, of which the Geological Survey, the Geodetic Survey and the seismic and gravity sections of the Dominion Observatory are all part, has set up a Committee for Seismic Regionalization to co-ordinate the work of these sections toward the production of a complete seismic regionalization map. The production of such a map is, of course, far in the future, but at least we are moving toward it.

Other risks

Our most probable loss in earthquakes is through the collapse or serious damage to buildings but there are two other risks which should be mentioned for the sake of completeness. The first of these are *tsunami*.

In 1929 an earthquake occurred on the Grand Banks of Newfoundland, about 250 miles from shore. It did practically no direct damage on land. However, because of some change in the ocean bottom, a large wave was set up on the ocean which travelled out in all directions from the epicentre. It was noted on tide gauges as far away as Bermuda and in the Azores but its principal damage was confined to Placentia Bay on the south coast of Newfoundland. Here the wave built up to a height of 30 feet, innundated several villages, and drowned 27 people.

Seismic sea waves have been particularly damaging in Japan and we employ a Japanese word—*tsunami*—in describing them. The cause of tsunami is open to some question but there is always a possibility that one may occur when an earthquake occurs under the ocean. Once the wave has been set up it propagates with the velocity appropriate to the water depth. The approximate formula in deep water is

$V=\sqrt{gD}$, where g is the acceleration of gravity and D is the depth of water.

If this formula is applied to the Pacific Ocean, where the mean depth is about 3½ miles, one obtains a velocity of some 500 m.p.h. The period of the wave is about one hour and the wavelength is, therefore, about 500 miles. A wave with such a wavelength, even if the amplitude is very high, is quite indistinguishable at sea. However, as the wave runs up on a shelving shore, with consequent reduction in velocity, the wave height builds up in order to conserve the energy in the wave and heights as great as 50 feet have been observed in Hawaii. If, in addition, the wave is running into a funnel-shaped channel, so that the volume of water is confined between narrowing walls, much greater heights may occur; heights as great as 90 feet have been observed in Japan.

The Grand Banks tsunami in moving into the funnel-shaped Placentia Bay built up heights of 30 feet. The Alaskan earthquake of March 1964 set up the tsunami which did serious damage on the Pacific Coast of British Columbia, particularly in the Alberni canal. These are the only cases of tsunami damage in Canada, which have come to our attention but it seems very likely that a country which has oceans on three sides must expect tsunami damage from time to time. One wonders what would happen if a large earthquake were to occur at an appropriate point in the Gulf of St. Lawrence. If a tsunami were set up, might the shelving and funneling effect both operate as the wave moved up the river? As far as we know this has never happened but it is something which might be taken into account in building large institutions close to the shore-line.

The other earthquake risk of which engineers should be aware is that of fire. There have been many cases in which disastrous fires have been caused by earthquakes; the San Francisco fire is perhaps best known to North Americans but the 1923 Japanese earthquake caused fires, both in Yokahama and Tokyo, in which the loss of life was appalling and very much greater than that caused by the earthquake itself.[22] In all three cases fire broke out simultaneously in many parts of the city, (in Yokahama, for example, it is said that there were 208 simultaneous fires started by the earthquake) and the water mains were destroyed by the earthquake so that no water pressure was available to fight the fires. The combination of these factors can be imagined.

It would seem that fire should have been a constant risk in Canadian earthquakes because we are large users both of electric power and of open fires in

furnaces and stoves, but it is a remarkable fact that no fires have been started in this way. Nevertheless, it seems to be a risk which people designing fire systems and water systems should be aware of.

Conclusions

It is hoped that this review will serve to make the engineering fraternity aware of earthquake risks in Canada. It is not my desire to be an alarmist but in the face of the facts which I have presented here it seems to me criminal that schools, hospitals and large apartment blocks should be built without any thought for the lateral forces which they may have to undergo in an earthquake. I hope that all readers of this article will look at Figure 1 and remember that *it could happen here*. The National Building Code tells how you may protect our people from this risk at a modest cost. The National Research Council through its Division of Building Research is carrying out research to improve the building code (the 1965 Edition of the Code is now with the printer) and to render the earthquake provisions more complete and less expensive to apply. We must not delay putting this code into effect. Tomorrow may be too late.▲

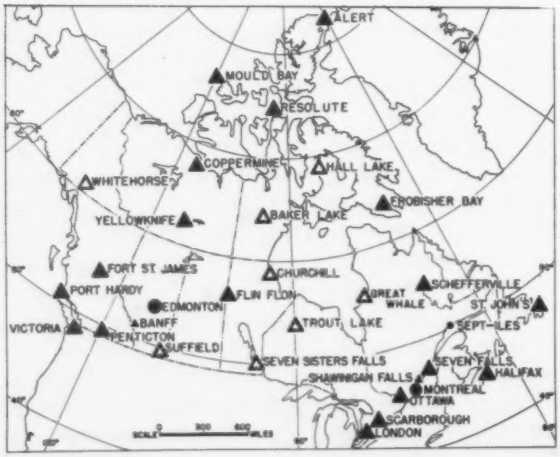

Figure 12. In 1959 the Department of Mines and Technical Surveys began to expand and improve the seismic network of Canada. When the network is complete no point in Canada will be more than 300 miles from a first-class seismograph station. This figure shows the status of the expanded network. Large symbols represent stations completely instrumented to international standard, small symbols stations with limited instrumentation; closed symbols represent existing stations, open symbols proposed ones; triangles represent government stations, circles private ones (Edmonton is operated by the University of Alberta, Montreal by the College Jean-de-Brébeuf and Sept-Iles by the Quebec, Labrador and North Shore Railway).

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EDUCATION AND TRAINING FOR CIVIL DEFENSE

PANEL "F"—"PROJECT HARBOR"

This extract from a series of reports resulting from studies of the problems of civil defence in the United States, is reprinted with the permission of the Office of Civil Defense, Department of Defense. Project Harbour was carried out by the National Academy of Sciences, under contract to the Office of Civil Defense. Under the leadership of Dr. Eugene Wigner, Professor of Physics at Princeton University, sixty leading scientists and engineers drawn from universities, private industry and governmental organizations were gathered at the Academy's summer study facilities at Woods Hole, Massachusetts, to examine the likely effects of enemy attacks on the United States, and the problems of civil defence of the country now and in the future. The group considered the technologies of offensive and defensive weapons systems, as well as those relating to passive defence. Particular attention was directed to problems of immediate survival; long-range recovery; political and psychological impact of various possible civil defence programmes; and civil defence education and public acceptance. The summary report was published in the Digest, Vol. 4, No. 3, June 1964.

Introduction

Physical protection from the thermal, blast, and radiation effects of thermonuclear weapons would be wasted if people are unwilling to use it, or do not know how. Likewise, a civil defense plan that neglects the preparation of the people for the many problems of post-attack recovery is seriously deficient. A vigorous program of education and training, therefore, must be an integral part of any civil defense program, large or small.

Building capability for civil defense requires the efforts of an inside nucleus of professional civil defenders able to use existing resources of knowledge, material, and manpower. Exercising that capability in an emergency would require a larger group of well-trained but non-professional outsiders.

An education and training program that does not consider both of these groups is liable to be inadequate to meet a variety of possible disasters, poorly adaptable to changing requirements, and of questionable acceptability to a democratic society.

Like a blast shelter, a civil defense education program should be solidly constructed, lest weak or neglected parts cause it to crumble when subjected to stress. One pillar of a sturdy program could be a body of people with special knowledge, and the other pillar a populace possessing widely disseminated general knowledge. To give two such pillars the strength of an arch, a keystone is needed, and the education program should make provision for it, too. Thus, there should be a National Civil Defense Institute.

The program to be described would have five objectives:

1. Development of a high level of knowledge regarding civil defense among technical and professional persons, including officials who have inherent responsibility for public safety.

2. Development of basic knowledge of the value and problems of civil defense among the general public.

3. Development of professional knowledge and skills within a professional cadre of civil defenders.

4. Development of emergency skills among the members of communities who can form a reserve force to be mobilized in an emergency.

5. Organization of a highly competent group of full-time specialists to pursue research and disseminate authentic information relevant to civil defense.

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These objectives might be attained in a variety of ways. Some of the ways suggested in this report are being followed in the present OCD program, and emphasis on them should be viewed as expressions of approval. Education and training measures certainly must be coordinated with other parts of a total civil defense program, and the scope and rate of development of such measures must be regulated by needs that develop.

Programs

Development of Professional and Technical Persons. The vast knowledge of persons now employed in professional and technical areas is one of the nation's most valuable resources for coping with the problems of survival and recovery from a thermonuclear assault. These human resources include active and retired persons with high-level experience in administration, construction, communications, health, transportation, and other areas, and the skilled personnel of federal, state and local government agencies. They also include advanced students in this area. Such persons could contribute more substantially to civil defense, both in the building and operation phases, if they were made aware of its special requirements, and were brought into the program in appropriate ways.

Short courses in specific subjects could be developed and made available to such persons through professional and technical societies and groups. Small additions might be made to college curricula, lectures given at professional gatherings, articles prepared for appropriate journals, and special educational television programs broadcast to increase the potential of professional and technical people.

Many engineers, for example, might benefit from instruction in shelter design; many doctors, from greater acquaintance with radiation sickness and blast and fire casualties; many teachers from guidance regarding dealing with children in emergency situations; and many police officers from closer study of civil defense plans and regulations. (See Appendix A for more discussion.)

Information for the General Public. Civil defense measures can be built and maintained in peacetime by a segment of the people, but survival and recovery from an attack would demand the best efforts of all. The education and training of the public should assure a reasonable attitude toward civil defense and foster appropriate action should a disaster occur. A four-part program would help attain this objective:

1. Adult education: This could include a general orientation course, and self-help courses in selected areas, offered by well-qualified instructors.

2. Employment-connected orientation: This part of the program would be designed for introduction through employers, unions, or other job-related contacts, and would not require instructors.

3. Public information: This would be material designed for utilization by mass media.

4. Secondary education: This would encourage the introduction of information about the nuclear age in the curricula of secondary schools. Attracting and motivating participants is a major problem in educating and training the public. An approach deserving greater emphasis would be to appeal to leaders of important groups, e.g., labor unions, large employers, governmental agencies, etc. Acceptance of public education might also be enhanced by freeing instruction from dependence upon current program emphasis, and by organizing material in small and convenient packages (*See* Appendix B for more discussion.)

Training a Civil Defense Cadre. Increased federal responsibility and involvement in civil defense, as discussed by the Immediate Survival and Post-Attack groups, promises a civil defense effectiveness level far beyond that now being realized. To realize this potential, a cadre of professional civil defenders of about the size of the Federal Aviation Agency would be required to build and train an operating organization. The adequate education and training of such a cadre will involve:

1. Establishment of a preparatory training and orientation program for recruits to the cadre.

2. Establishment of a command school to prepare cadre members for advancement and command responsibility.

3. Establishment within the command school of a planning section to work in close collaboration with the National Civil Defense Institute, yet to be discussed, in development of general policies and procedures for the civil defense establishment. (*See* Appendix C for more discussion.)

Instructing a Civilian Reserve. It is not feasible to create and train a professional cadre large enough to man completely all lines of an adequate civil defense organization in a major disaster. A well trained civilian reserve also will be needed. It can be recruited from local and state government officials, former army reservists, and other elements of the general population having desirable skills and backgrounds. Such a reserve body can only function effectively as a well-integrated organization subject to control, authority, and direction in an emergency, if it is prepared to do so during the planning phase. It should be organized, trained and held to high proficiency by a professional cadre. Training activities would include:

1. Establishing procedures for the civilian reserve. This training should emphasize system proficiency of the entire civil defense operating organization during an attack and should go far beyond simple training of individuals in special skills.

2. Establishing an in-shelter training proficiency which would be able to teach the survivors basic "nuclear hygiene" and instruct them about post-attack recovery plans and procedures.

Creating a National Civil Defence Institute. The problems of civil defense will continue to require the attention of the most able scientists from many different disciplines. The creation of a National Civil Defense Institute is recommended on this account. This Institute could be a key element in the total education and training program, provide the impetus toward new and better approaches to old problems, and also provide authoritative evaluation of currently available solutions. Its activities could strengthen the work of the professional civil defender cadre and feed the training program for the civilian reserve. Its work could command the respect and interest of technical and professional communities, and through its prestige help to stabilize and improve the public reaction to civil defense.

The proposed Institute would have research as its primary mission, but also would have a closely related teaching responsibility. It should be organized and administered in a manner that would give its members opportunity to accomplish significant research, assure them freedom of inquiry, and thus attract a qualified staff. Its teaching function could emphasize the dissemination of new information through seminars, conferences and short courses. These courses would be available to various groups including:

1. Instructors of technical and professional persons.

2. Periodic survey courses for professional civil defense corps.

3. Representatives of manufacturers and industrial consultants.

4. Armed forces officers and technical personnel.

A National Civil Defence institute could become a major force in giving direction to the entire education and training program, and in binding its parts together to form a well-coordinated whole.

Popular Involvement in Civil Defense

One of the crucial questions in planning, training, and education is the extent to which the public must be involved in the civil defense program.

It can be argued that the best situation, the most efficient and most acceptable to the nation, is one in which only an elite cadre is trained in civil defense, leaving the rest of the people essentially undisturbed. This would be analogous to the system adopted for our armed forces. The armed forces exist as a professional, highly trained, common defense service; a service which the public is willing to support with generous amounts of money, in which it has considerable faith, and with which many want to be involved as little as possible. These forces are deemed sufficient to defend the country's interests in many situations, and should the world again be plunged into a general conventional war, it is believed that they can expand to cope with any foreseeable conflict.

The notion of entrusting a needed service to a specialized and trained professional unit when applied to civil defense, is at first sight most attractive. It suggests that we create for civil defense a small, efficient, organization; one which can be easily visualized and whose acceptance by the public would be undoubtedly high. A closer quantitative look, however, shows many flaws.

To qualify as small, efficient and not too costly, this organization could be no larger than 50,000 members, but analyses of planning, attack and immediate post-attack requirements of protecting the civilian population from destruction by a nuclear war, indicates that this number is too small by almost two orders of magnitude. Let us look at the situation in detail: For 1,000 people in a shelter, it is certainly not excessive to have available two radiological monitors, two people trained in decontamination, two people who, in the absence of a physician, can adminster drugs (not simple first aid), two people who can use and repair vital communication equipment, and so on. This kind of analysis leads to a minimum of from 16 to 50 trained specialists for every thousand of population. If we use the more conservative figure and assume only fallout shelter for all as a basic requirement, we quickly see the need for two or three million well-trained people rather than a small professional force of 50,000.

This force might be available if there were a civilian reserve to support the small professional unit, a reserve that can be a trained, organized body of people who have peacetime occupations that parallel their reserve assignments, and whose skills are usable by expanding them slightly to meet the special requirements of the emergency situation.

To be effective, the civilian reserve should be made up of the people in the community who both have the proper skills to meet emergency problems and command the respect of their fellow citizens. Some examples: a respected lawyer might make a good leader in one shelter, but depending upon its location, a shop foreman might be more desirable; a former medical corpsman can be trained for health service, and a ham radio operator would serve willingly and well in the communication field. In an emergency these people can take charge, and also provide an emergent social and technical leadership for the immediate post-attack period.

We do not deny the need for a small, full-time professional civil defense organization: it must exist in any effective civilian defense program. But is must be supplemented by a large civilian reserve which can draw on the peacetime skills of the population, and redirect them in an emergency. It must be available on a few minutes notice.

We further point out that such a civilian reserve cannot be organized and trained in an emergency. First, there may not be time, and second, the crash organization of the civilian population itself might be such a

great step up the escalation ladder that it would precipitate an immediate attack. Further, an emergency training program for three million people, in a crisis, would have profoundly disquieting side effects on the rest of the population. In the face of this, the advantage to a President who might wish to use this emergency training program as a move in an escalation strategy, appears minimal.

We now see the need for a professional, full-time nucleus of 50,000 people, and a reserve body of about three million. What about the rest of the population? We believe that some involvement is possible and desirable for about 20% of the adult population. This is not to include training, or a place in the civilian defense operating organizations. However, the nature of this involvement could be in orienting the citizen, informing him of the problems to be faced during and after a nuclear attack. He should, however, know about very general problems of a post-attack nation, and learn about special personal things he can do in case of an attack, such as not look at the fireball. A mixture that combines dependable knowledge of the big picture with personal self-help information for him and his family's protection would be palatable, and perhaps even desired by a large part of the populace.

Crisis, Austerity and Phasing

Crisis Situations. It is useful to consider special requirements for education and training in a situation in which it becomes desirable to enter a crisis program for the rapid buildup of civil defense. Requirements created by such a situation do not appear to change substantially the desirable posture of civil defense education and training. In general, it seems clear that the best preparation for such crisis events is the same educational and training program required for a "ready" posture. A sound knowledge of the requirement for civil defense among professional and technical groups, the general public, and those directly engaged in regular civil defense tasks, i.e., the Civil Defender Corps and the Civilian Reserve, is likely to be the best basis from which to mobilize a "crash" effort.

Except in an extended crisis situation, e.g., 6 months or more, special efforts to educate or train are liable to be much less effective than directing specific information and specific instructions to specific segments of the population. It is suggested, therefore, that attention be given to the development of a variety of crisis plans detailing what information and what instructions are to be given to whom. A variety of such plans is needed, since the specific content of information and instructions must depend upon the specific crisis and the status of the "ready" civil defense program at the time. In order to provide for rapid and flexible action to meet crisis situations, it is suggested that a group of professional civil defense persons be charged with responsibility for the development and continual updating of a wide variety of alternate crisis plans. The effectiveness in execution of any such plan, however, will be quite dependent upon the same basic education and training that is required for "readiness."

Effects of Austerity on the Desirable Program. It was estimated that the complete five-part program for education and training, as described in detail in the appendices, would require an annual budget of approximately $200 million at maturity, which is of about the same amount as is now being spent by the Veterans Administration on education and training. Consideration was given to what changes in the desirable education and training program would need to be made if the support for the program was reduced by a factor of four, or to $50 million, and by a factor of ten, or to $20 million. It became clear that the best adjustment would not be an "across the board" reduction of the desirable program, but programs having somewhat different characteristics.

If support education and training were $50 million per year, a desirable program would be the following:

1. Organize and staff a National Civil Defense Institute.

2. Develop and carry out a modified emergency skills training program for key civilians in the Civilian Reserve. This program would seek to train approximately the same number of persons in the Communications area, but each of the remaining areas, e.g., Health, Fire, Police, etc., would be substantially reduced both in numbers of persons trained and the intensity of their training. Since at this level of effort it would not be possible to create an adequate training capability in the Civil Defenders Corps to train the Civilian Reserve, it is proposed that school teachers be used as instructors. The services of the best qualified teachers should be sought. They should be given special training and be adequately compensated so that their interest and enthusiasm could be maintained.

3. Give public education strong emphasis and provide pamphlets and general information for public consumption.

4. Train a small Civil Defender Corps on a very modest scale with emphasis upon encouragement of self-development.

5. Even if no organized program for technical and professional persons could be supported, it is suggested that efforts be made to continue to infuse knowledge of technical and professional requirements for civil defense, and that research and development be continued in critical areas.

A $20 million education and training effort would likely prove to be grossly inadequate if it were built along the lines suggested for the larger program, and, in order to achieve a modest degree of effectiveness, would need to be oriented in a manner to "seed" and "stimulate" other efforts. The suggested program would include the establishment of a National Civil Defense Institure, but on a scale about one-fourth of that

suggested for the larger program. Other education and training activities would be carried on much as suggested for the $50 million program, but on a much reduced scale. Emergency skills training might again stress the Communications area, school teachers would be recruited for instructors, and the number of persons trained would likely fall quite short of one million persons.

Phasing. It is unlikely to be possible, and, in fact, is undesirable, to move immediately from the present level of civil defense education and training, 15 to 20 million dollars per year, to the level considered most desirable in this report, $200 million per year. It is important, therefore, to consider what would be the most desirable rate at which to move ahead, and what would be the best manner to proceed. The education and training program in many areas must follow other steps taken in the building of the overall civil defense system. For example, the amount of effort spent developing a capacity within the Civil Defender Corps for training a Civilian Reserve depends upon the personnel strength of such a Corps, and upon the success of prior work in building the Civilian Reserve. Progress toward the establishment of a National Civil Defense Institute will be regulated by time required to recruit a qualified staff, and to find or construct necessary facilities. Even such educational programs as those designed for adult education or for technical and professional personnel may be slow in reaching the desirable level of activity because of the need to review and revise curriculum, and to develop a sound basis for motivating volunteer participation. As the program is built, it will also be necessary to consider the balance between the value of the program in the short range as against its value in contributing to the longer range program. Desirable short range goals are not necessarily consistent with longer range objectives. All these considerations prevent suggesting a detailed schedule for the rate and direction of desirable growth. However, it seems reasonable to assume that a minimum of 4 to 5 years would be required to grow efficiently to the desirable level. ▲

Essential Records For Industry

In the event of disaster striking, experience has shown that a business firm can be seriously hampered in its effort to return to normal operations if some or all of its records have been lost or destroyed. As a guide to companies in developing an effective program of management for their essential records, the Department of Defence Production, through its Emergency Supply Planning Branch, has recently published a booklet entitled "Essential Records For Industry".

The booklet contains information on the general approach to records management in industry with special emphasis on the problem of essential records. Guidance is provided on their selection, duplication and storage. As well, information on a model essential records program undertaken by a Canadian firm is included. There is a reference section on the legal admissibility of photo-copied documents as evidence.

The preliminary studies and the development of the booklet were carried out by a team of specialists from the Records Centre Division of the Public Archives of Canada. They interviewed representatives from thirty businesses including manufacturing, retail, and utilities, as well as bank and trust company associations.

Copies of the booklet are available in both English and French versions and may be obtained from the Emergency Supply Planning Branch, Department of Defence Production, Ottawa, Ontario, or through its Regional Offices across Canada. ▲

UNITED KINGDOM CIVIL DEFENCE

Excerpts from an address by Air Chief Marshal Sir Walter Merton GBE, KCD, Inspector General of Civil Defence, Home Office. Presented to the Association of Civil Defence Officers, May, 1965 and reprinted from the Journal of the Association of Civil Defence Officers Vol 12, No. 3, August 1965.

FIRST of all let me say how pleased I am, as a Sassenach, to be in this delightful city of Edinburgh once more, even if it is only for a short and fleeting visit. My pleasure is the greater as it gives me the opportunity of renewing my acquaintance with so many old friends amongst the Civil Defence Officers.

I found myself in some difficulty when I came to consider what I should say to you this afternoon for, as you all know and has been mentioned so often in the last two days, civil defence in common with the fighting services and many other organizations is under review by the government. The Home Defence Review Committee, which has been set up at a high level and which is charged with making recommendations to Ministers, is still sitting. What their recommendations will be and what decisions on them will be taken by Ministers is anybody's guess. I certainly do not know but all I can say is that I am optimistic about the final outcome.

You must realise therefore that anything and everything I say today is either based on current policy or my own personal opinions. I might well be proved wrong, but I hope not.

In this talk I propose to indicate why I think home defence planning is vital today and then go on to give you a brief outline of the likely form of the threat and then to say a word or two about the Warning and Monitoring Organization. To finish up I will say a few words about the re-organization of the corps.

I deliberately used the term "home defence" planning just now for, in my view, civil defence has rather a too narrow connotation. I regret to say that some local authorities, but as I said yesterday by no means all, some of you may I know think too many are inclined to accept this narrow view and think that if they raise and train an effective and efficient division of the corps they have discharged, in full, their statutory responsibilities for civil defence. Civil defence extends far beyond this, far beyond the operational phase.

If your authorities take the narrow view it is up to you to do your utmost to get them to understand and accept their full and wider responsibilities. These, as we were reminded yesterday, include ensuring that staffs who have no functions in the period immediately following a nuclear attack are re-allocated to a wartime post and, what is more, are trained in their wartime duties. Their responsibilities also include the preparation of the detailed plans to ensure that survivors continue to survive so that they can rebuild the shattered nation. As Mr. Ruff said yesterday, we are a resilient race—what was possible at the time of the Black Death in 1348 is possible today.

I only wish we could dispell the belief held by such a large proportion of the population that it is no good doing anything about civil defence—a belief brought about no doubt by a conviction that they will either all be killed in the initial assault—or if they are not killed then, probably remembering what they read in that frightening book by Nevil Shute *On the Beach,* that they will sooner or later die from the effects of radiation. You know and I know that this is nonsense and, what is more, our scientists have assured us that in the face of an attack on the scale thought likely, the survivors will be numbered in millions—many millions taking the country as a whole. This clearly high-lights the need for effective home defence planning and, what is more, planning in time.

Having stressed the need for planning, you might quite properly ask me is it really necessary. I am certainly no prophet so I can only point to you a number of factors on the international scene which, I hope, will convince even the most optimistic or should I say the most pessimistic, that we must take out an insurance policy in the way of civil defence even if we cannot afford to take out a fully comprehensive one.

Few will deny that peace has been maintained by the power of the NATO Alliance. The recent white paper re-affirms the effectiveness of NATO as an instrument to maintain peace. Those of you who may not have seen it may be interested to hear what it says so I will quote the relevant paragraph:

> "The threat to Britain's survival can be met only by the strength and unity of the NATO Alliance through which the United States, Canada and the countries of Western Europe affirm their interdependence. Our aim in NATO is to preserve peace by effectively deterring aggression, thus creating the conditions for a further easing of tension and measures of disarmament, including arms control and a reduction of defence expenditure by both sides. The success of NATO in achieving collective defence has been a major cause of the growing stability in relations between east and west. The Alliance must maintain its strength and solidarity without undermining the opportunities for progress towards disarmament".

It is certainly true to say that in recent years there have been a number of heartening developments vis-à-vis Soviet Union. One is the Test Ban Treaty Mid 1963 which is a first step to disarmament. A second, the April, 1964, statement in which both Mr. Johnson and Mr. Kruschev announced the reduction of the planned production of fissile material for military purposes. The then Prime Minister associated the United Kingdom with these statements.

This is all very good. You may say then why bother about civil defence. *But* one must not lose sight of a number of factors on the debit side:

(1) No reduction in stockpiles of nuclear weapons;
(2) No halt in development and production and delivery of vehicles;
(3) The dismissal of Mr. Kruschev;
(4) China detonated a nuclear device;
(5) The many dark clouds in the Far East—Vietnam, Laos and Indonesian confrontation. These could develop into wars involving the West which could escalate.

Though the recent white paper does assure us that there is a much reduced likelihood of war between the Soviet and the Western Alliance, it does also point out that we must maintain our guard.

The possibility of war does certainly still exist. Maybe it is remote but we cannot ignore the possibility and we must always stand ready. I am reminded of this by the late Sir Pierson Dixon, a man whose opinions I respect. In an address to the Anglo-American Press Association as recently as the 18th January, 1965 he said that:

> "He believed that in the course of policy making account must still be taken of the risks of war through error or miscalculation. If full scale war was no longer expected, it was not yet inconceivable".

What I have said must, I am sure, make it clear that civil defence or home defence planning is a must.

If you accept that war is still possible you might well ask what is the likely form of the threat. Clearly I am in no position to reveal the J.I.C. assessment. The best I can do is to give you some information about the Soviet Strategic Air and Rocket Forces which I have obtained from Jane's *All the Worlds Aircraft* and from a pamphlet entitled *The Military Balance 1964-65* published last November (1964) by the Institute for Strategic studies. No doubt they are not far removed from the truth.

In 1964, Russia was alleged to have some 200 inter-continental ballistic missiles (I.C.B.M.) with a range of the order of 5,000 miles; this number was expected to increase substantially during 1965. In fact we saw new weapons paraded in Moscow. Of the 200, one-third is thought to be of the second generation, which means they are propelled by storable liquid fuel which makes them easier to conceal and improves readiness. Both the first and second generation weapons have powerful boosters and though each can carry very high-yield warheads, there is no evidence to show that they could carry war-heads of the order of 50 megatons into a ballistic trajectory. If we accept both these figures and those quoted by Mr. Johnson in his message to Congress in January 1965, the Americans have a superiority in numbers approaching 4 to 1.

For protection, though it must be assumed that sites are being hardened, the Soviet are thought at present to rely mainly on concealment and active defence measures. But when we talk about active defence measures it is worth noting that they have made no claims to progress, in anti-missile systems, comparable to those made by Mr. McNamara in the States in September last year (1964).

As for medium range (M.R.B.M.) and intermediate range (I.R.B.M.) missiles, the Russians appear to have a total of somewhere between 700 and 750. The M.R.B.M. are of two types—one with a range of some 700 miles and the other 1,100. The I.R.B.M.'s on the other hand, when fitted with two stage liquid-fuelled engines, are thought to have a range of up to 2,100 miles. Most of these weapons—medium and intermediate range alike—are generally supposed to be based near the western and southern borders of the Soviet Union, on the Pacific Coast and in Siberia. They are, therefore, well placed to cover most strategic targets in this country, Western Europe and much of the Far East.

Now a word about the Soviet Air Force. The strategic element called the Long Range Air Force, is known to be considerably inferior in strength to the U.S. Strategic Air Command, even leaving out of consideration our own Bomber Command of the Royal Air Force. But the Russians do possess in addition to their long range force a very large number of medium bombers. During the Geneva Disarmament Conference to discuss a "bomber bonfire" they made it clear that they still consider them an important element in maintaining their security.

The Long Range Air Force is equipped with some 70 turbo-prop T.U.95 (Bears) and 120 four Jet Bisons. The Medium Bomber Force consists of about 1,000 twin-jet T.U.16 (Badgers). These, it is thought, may be in the course of being replaced by a more new high performance twin-jet (the Blinder). This aircraft has a supersonic dash capacity.

The nuclear power of the Soviets derived from its missile and air force is reinforced by its submarine fleet. Of the 400 conventionally-powered and 30 nuclear-powered submarines, some 40 can carry an average of 3 missiles each. But only a proportion are thought to have a limited capability of submerged firing—and none of the missiles have a range comparable even to the earlier marks of Polaris. In fact all we know with any degree of certainty is that some submarines do carry a surface-firing ballistic missile with a range of the order of 400 miles.

We can, I think, deduce from this that though no doubt *all* the 200 Inter-Continental Missiles and *all the Long Range aircraft* will be aimed at North America and the United States in particular, there will certainly be sufficient medium range aircraft and medium and intermediate range missiles left in the armoury to enable the Russians to launch, with little warning, a devastating attack not only against this Country but also against NATO Europe and targets in the Middle and Far East.

As a devastating nuclear attack could undoubtedly be launched against this country, and with little warning, you might ask what is being done to give the public tactical, as opposed to strategic, warning. To provide this tactical warning we are fortunate in possessing a well developed warning and monitoring organization to give notice both of attack and of the arrival of fallout . . ." ▲

CIVIL DEFENCE IN NORTH AMERICA

The nature and relationship of Civil Defence in Canada and the United States were presented to the 1965 Conference of the California Civil Defense and Disaster Association in September 1965, by J. F. Wallace, Director, Programme Implementation, Canada Emergency Measures Organization, and William P. Durkee, U.S. Director of Civil Defense. Following are the texts of the two presentations.

CANADA

J. F. WALLACE

Director, Programme Implementation Branch
Emergency Measures Organization

The historical development of post World War II civil defense in Canada is quite similar to that of the United States particularly in relation to the spurts of progress, the frustrating delays in getting things done and constant reorganizations to improve programmes. Nevertheless, since 1949, when I became associated with the programme in Canada, I can truthfully say that progress has been made, and is continuing to be made, and with constant injection of new and young blood into our respective organizations, I am firmly convinced that as time goes on our respective nations will be better able to withstand the onslaughts of war, and most certainly will bring about a more cohesive method of dealing with major (and minor) peacetime catastrophes or emergencies. The Canadian Government considers civil emergency planning as an integral part of the total defense of the country and, consequently, recognizes that civil defense will be required and is necessary as long as military defense is required.

Like many of you I too at times have grave doubts about our current capacity to do the things we know are correct should the awfulness of nuclear war ever become a reality. In many ways we are pioneers in this work. We are looked upon by well meaning, and not so well meaning, people as being passe, militarists, theorists, impractical and so forth. Yet it was not so many decades ago that those who were pioneering public health were confronted with similiar opposition. Today everybody wants more and better public health. Who knows, and God permitting, we may see a similar acceptance of our programme in years to come.

In Canada, I would suggest that the programme of civil defense is starting to become somewhat more respectable in the minds of the public. There are a number of reasons for this, and I would like to mention a few of them. Civil Defense or Emergency Measures has become an accepted responsibility of our municipal governments. At one time, those who dealt with emergency planning in Canada were looked upon as mysterious creatures paid for by government but not part of government.

Those who are now engaged in emergency planning have become more professional in their day-to-day work. They have learned how to coordinate and cooperate with other departments of municipal government. They have learned that a municipal council is the executive authority and that its involvement is essential. The federal government some years ago introduced a series of courses at the Civil Emergency Measures College for the education of mayors and heads of local councils. We run two such courses each year, one in the English language and one in the French language. These courses have done a lot of good in that each year some 150 Mayors go home with a good understanding of the civil emergency planning programme. We accept the fact that some may not be reelected, and consider our investment of paying their full expenses as a sound one.

Another facet of this question of respectability revolves around the old chestnut of "public apathy". I am afraid too many people throughout our organizations in Canada have used this as a crutch to justify inaction. It is our view that to try and stir the public to the awareness of the dangers, which can only be truthfully classed as probabilities or possibilities, will only bring about frustration. The important thing for emergency planners to do in these "days of peace" is to ensure that we get our "professional house" in order. That is to say, that our everyday emergency services have trained their staffs and know what to do; that emergency headquarters (your EOC's) are operational, and above all that everything is prepared and in hand to provide the information and advice to the "apathetic" public when it chooses to shed the cloak of apathy. Let us face it, in a crisis or during an emergency, people are quite responsive to leadership. I hope that none of us lets the public down should the test confront us.

Another matter which has helped local emergency measures has been the involvement of our staffs in peacetime disasters. Fortunately, in Canada, we have not had the major disasters which have confronted many of the States and municipalities in the United States. Nevertheless, as small as our disasters may have been, our emergency planning groups have garnered to themselves a lot of justifiable commendation. We are doing everything possible to encourage our entire Organization to prepare peacetime disaster emergency plans. I should point out that we do not necessarily expect the local directors or coordinators as we call them, to be the Commander of Disaster Operations. This depends upon the type of disaster which confronts them. In many cases the operation is one of providing supporting services to an existing service. For example, in the Province of Newfoundland whenever there is a major forest fire, the forestry officials are in complete

charge of the operation. The emergency measures coordinator for the province provides the backup services of public information, emergency feeding and other welfare services, as well as a host of other activities. This arrangement permits the forestry branch to use all its professional people on the major task.

At this point, I would like to apologize for what might be termed philosophizing and now turn more directly to the subject on which I was asked to speak, that is Civil Emergency Planning in Canada.

Background of the Programme

Our emergency planning programme got underway in 1948, in the days of the model T bomb. Like you in the United States we leaned heavily on the lessons of World War II and the advice of the United Kingdom. Our efforts then were directed to trying to organize emergency services, particularly fire, rescue and medical, with a heavy emphasis on the need for recruiting and training of volunteers. Up until 1959, apart from the emphasis on pre-attack evacuation planning in 1954, civil defense activities were not particularly well understood by government or by the people directing the programme. The total annual financial appropriations during the first ten years never exceeded $4½ millions. However, a change was taking place and for the good.

In 1957 the federal government, as a result of a far-reaching study by some very astute public servants, established an emergency measures organization in what you would call the Executive Office of the President, but which we in Canada call the Privy Council Office. Its purpose was to produce a plan, and a system of decentralized government, whereby the federal government would, in the event of war, be able to discharge its responsibilities.

So in 1957, at the federal level of government there were two agencies of government which had separate emergency planning responsibilities. In 1959 the two agencies were merged, and henceforth the federal emergency measures organization became fully responsible for developing and coordinating emergency planning, not only with departments and agencies of the federal government but also for assisting and coordinating provincial activities. In effect, the Canadian Federal Emergency Measures Organization carries out many of the tasks which are carried out by your Office of Civil Defense, and your Office of Emergency Planning.

The federal EMO comprises in total just over 200 persons, half of which make up the staff of the Civil Emergency Measures College. In addition, at the federal level seventeen departments have full-time emergency planning staffs. At this time, I might mention that each department or agency of government has been assigned emergency planning responsibilities. Many of these have simply the responsibility for making plans to reconstitute their departments following a war, and to make plans for their employees.

Policy is formulated by a special committee of the federal cabinet, and it is the responsibility of federal EMO to recommend policy measures and when approved to have them implemented. Because of the nature of our constitutional makeup we must be careful in our dealings with our provinces. To improve liaison, we have a federal provincial committee which is made up of the Cabinet ministers, federal and provincial, who are responsible for emergency planning at the federal and provincial levels of government.

Each of our ten provinces and two territories have provincial emergency measures organizations. Their sizes vary according to the size of the province. Below the provinces, the set-up pretty well parallels the arrangements in the United States, and the things that have to be done are the same as they are here.

I would now like to tell you of some of the preparations which have been made, and some of the programmes which are underway or are about to start.

Emergency Government Facilities

We have a complex of protected facilities, outside of Ottawa, into which we will move the key elements of government in the event of war. These facilities are operational.

In each province we plan to have a Regional Emergency Government Headquarters. In each Headquarters will be located key elements of the provincial government, some federal officials and a component of the military. Six of these headquarters are completely operational, are fully protected against fallout, and are equipped for 30 days continuous operation. The remaining four will be built over the next four years, with one to be completed this year.

In addition to these Regional Headquarters there will be constructed what we call relocation sites to house backup personnel for these Regional Headquarters. These relocation sites will in all probability be located in the basements of existing buildings. Money is available now to improve some of the basements.

Below the Regional Emergency Government Headquarters we plan on building some 34 zone Emergency Government Headquarters. These zone headquarters will comprise groupings of counties and municipalities. The zone headquarters like the regional centres will have combined federal and provincial staffs. Whereas the costs of the regional headquarters and the relocation sites are carried completely by the federal government, the cost of the zone headquarters are shared 75% federal and 25% provincial.

Within the zones will be the municipal organizations each, we hope, with its own emergency headquarters. The federal government shares in the costs of such headquarters paying 75%. So far most of these headquarters are located in the basements of existing buildings. They have been proofed against fallout. In all we would expect something in the order of 300 municipal emergency government headquarters to complete the plan. Most headquarters provide the directing elements

for groupings of two or more municipalities. In all there are some 4,000 municipal governments in Canada.

The communication links are in existence for most of the system. Teletype and radio backup are the major features of the communications from zone through to the central facilities. Below the zone, and more particularly in the less threatened areas, more reliance is placed on telephone, although in many cases it is provided with radio backup.

Warning

The Canadian Army is the responsible agency in Canada for warning the public of the likelihood of attack and fallout. It has representatives at NORAD Headquarters and in a number of the NORAD Regions. Like your system in the United States, it operates on a 24-hour basis, and makes use of sirens to warn the public. One major difference between our two systems is that the province and municipality have no say as to when the public warning is given. When authorized by the Prime Minister of Canada, the whole system is activated from the federal warning centre outside of Ottawa. Once the authorization has been given, the Army sounds the Alerts and Take Covers, or makes any changes in these conditions of alerts as are required.

Emergency Broadcasting

The Emergency Broadcasting System, I feel, is really the back-bone of all our survival measures. All radio and TV stations in Canada can be switched in a matter of minutes into a single system, or the system can be broken down into segments which would conform to provincial boundaries. The system is operational and the six key transmitters are fully protected, and have been provided with emergency power. In the key studios of the system there are located the initial radio broadcast announcements on tape, which will automatically be put on the air when authorized by the Army Warning Centres. These initial broadcasts will be given from peacetime locations but subsequently will be given from each Regional Emergency Government Headquarters.

Shelters

Although we in Canada got underway in carrying out fallout protection surveys before you did in the United States, it was only this year that we were authorized to carry out a national survey. As a result of the operational experience you have had, we in Canada will most certainly benefit from your experiences. On the basis of pilot surveys of one kind or another we certainly expect to find a substantial number of shelter spaces for the public. Although authorized to proceed with the survey we have not as yet been authorized to stock or sign these shelters. Nevertheless we do feel that these are the next logical steps.

In the meantime we keep in close touch with the United States on this vital aspect of survival.

Radiological Defence

For the past three years we have been purchasing sizeable stocks of radiation detection equipment for use by municipal organizations. The equipment includes two ranges of dosimeters, high range survey meters, and this year a low range meter which will serve both training and operational requirements. To go some way in ensuring that the equipment is operationally ready, we have a maintenance contract with a private firm which checks each instrument each year, or on demand by the user. The cost of this contract is carried by the federal government.

Medical Stockpiles

For over ten years our Health Department has been building up reserves of medical supplies, including 200-bed emergency hospitals. These supplies are stockpiled in Regional Depots, and are in the process of being prepositioned in key communities away from likely targets. The cost of the medical supplies has been accepted as a federal responsibility. The provinces are responsible for finding adequate storage facilities and training the required medical staff in the use of the supplies.

One interesting feature of emergency health planning has been in the area of hospital disaster planning for peacetime emergencies. If a hospital does not have an approved plan to deal with peacetime disasters, it is not entitled to the highest accreditation rating by the Canadian Hospital Association.

A distinctive feature in Canadian planning relates to the responsibilities of the Canadian Armed Forces. In the event of nuclear strikes on Canadian territory the Canadian Forces automatically are responsible for controlling and directing any lifesaving measures in the area attacked. This responsibility extends over all civilian forces in the area.

In addition to these major features of civil defense planning, there are being developed a large number of supporting elements, such as a War Supplies Agency whose job it will be to control all phases of production and supply of consumable goods; a national manpower authority to direct the use of labor; a wartime accommodation agency to provide housing or accommodation; integrated federal/provincial agriculture services; a road transport control organization and so forth.

Financial Assistance Programme

I would now like to tell you something of our Financial Assistance Programme for provinces and municipalities. This is the programme by which municipalities in particular are assisted in financing their emergency planning activities. In general we support municipal expenditures by paying 75% of the costs of administration, equipment and construction. Our programme is all inclusive. Like all federal governments, we also place a limit on the amounts which can

be spent annually. Since 1959, provinces and municipalities have increased their expenditures steadily from approximately 54% to 92% of the available funds. Currently, the allocation of the money to provinces is on the basis of population. It works out to something like 27c per head.

However, in the past few years we have been concerned about the lack of completed plans by both provinces and municipalities. Within the next two years we will be introducing a system of incentive payments. The basic grant to provinces is based on 15c. per head—mainly to cover existing administrative costs. As plans for various types of operations are completed we will provide extra money. What eventually will become available in dollars and cents will be more money than is available now.

In addition, like OCD, we will be introducing programme management techniques to our planning activities. All these measures are designed to increase the efficiency of local organizations, as well as to maintain a progressive programme of emergency planning activities.

It may interest you to know that the annual total federal expenditures on emergency planning are slightly more than one dollar per head of population. These expenditures include all funds expended not only by Federal EMO, but by all departments and agencies of government.

Canadian—United States Relations

Before concluding my remarks, I would like to say something about Canadian/United States relations. The fact that our two countries have an exceedingly long common border practically forces us to recognize each other in practically every phase of activity. This is particularly true in the area of civil emergency planning. Ever since 1948 when civil defense activities were reactivated in both countries there has been a constant flow of visits between the authorities in both countries. In 1952, an agreement was consumated to put on a legal international basis the arrangements which seemed sensible. In 1963, a new agreement was ratified by the two governments to bring up to date the original one.

As a result of these activities, much of our planning progresses on parallel lines. Additionally, and possibly more important, we will be establishing this year emergency communication links between our border regions; the operating procedures for reporting radiation fallout have been standardized and right now several States and provinces are working out local arrangements to implement them; our radio broadcast messages are consistent so that persons will not be confused if they happen to pick up a broadcast from the other country. In addition to these measures, there is now building up a series of meetings between individual states and provinces. The ultimate purpose of these meetings is to ensure as far as possible that planned operational activities will not be inconsistent.

From a Canadian point of view our relationships with the United States have been exceedingly profitable to us. The generosity of your Washington and Regional Offices of OCD and OEP has been a real source of encouragement to emergency planners in Canada. I realize, of course, that apart from sending thousands of immigrant Canadians to the State of California, that these cross-border arrangements are unlikely to affect your emergency planning activities. Nevertheless, I am sure you are interested to know that in the event that a nuclear war ever does take place, both Canada and the United States are committed to come to each other's assistance to alleviate insofar as possible the suffering and anguish of our respective citizens.

* * *

UNITED STATES

WILLIAM P. DURKEE
Director of Civil Defense
Office of the Secretary of the Army

My subject, as described in the agenda of this annual conference, is "The Civil Defense Program."

If you have faithfully attended other meetings arranged as part of this conference—and I must assume that you have—you have received important information covering radioactive fallout and defense against it, the shelter program, State and local emergency resources preparedness, civil emergency planning in Canada, the responsibilities and actions of the North American Air Defense Command, the role of military support of civil defense, and other important topics related to this program of preparedness.

May I suggest, ladies and gentlemen, that in large measure you have already heard about the quote—"Civil Defense Program"—unquote.

As one trained in the law, therefore, I think it would be entirely legal for me to conclude my remarks and be seated at this time. But frankly, I didn't travel 3,000 miles to be quite that brief.

There are two major points I want to make today. They are not new. They may not be exciting. But in my opinion they are fundamental to the deliberations of this conference.

The first is that, despite the problems we face, the nationwide civil defense program—recognized as an integral part of strategic national defense by the President, by the Secretary of Defense, by the Secretary of the Army, by the Chairman of the Joint Chiefs of Staff—will continue in 1965 and the years ahead with increased vigor.

And the second point—a crucial one, in my judgment—is that the theory that civil defense is organized and conducted within the legal structure of representative *government* is a sound theory. In many, many communities it is much more than that. It is a *fact*. And in these communities, civil defense preparedness is

strong and is getting stronger. But in too many communities in the United States this theory has yet to become a fact. And to the extent that it is not a fact in *every* community throughout this great Nation—a fact recognized, accepted, and acted upon by responsible government officials—to this extent, the structure of United States civil defense is weakened.

We need strength, not weakness. And I can assure you that I am prepared to do anything within my power to achieve that strength. I assure you, also, that I expect the same efforts from you who are directly engaged in this endeavor.

Expansion of the Program

Now my first point was that this program will continue with increased vigor. Let me give you a few examples of what I mean.

We expect the continuing National Shelter Survey to locate public fallout shelter space for 6,000,000 more Americans in the coming year. This is in addition to the public shelter space located to date—space for more than 137,000,000 people in 762 cities and 2,823 counties throughout the Nation.

We know that not all of this shelter resource is well distributed in terms of population, and we will get more specifics on this subject when we get deeper into the Community Shelter Planning Program, which I will discuss in a moment. This total resource, however, is available and much of it is being prepared for emergency use. Public shelter space sufficient to accommodate more than 77,000,000 people already has been licensed and marked with public shelter signs. States and localities have stocked this space with federally purchased survival supplies—food, water containers, radiation detection instruments, medical and sanitation supplies—which would sustain more than 35,000,000 people for two weeks and more than 58,000,000 people for an eight-day emergency period.

Recent studies show that many of these shelter facilities do not require all or some portion of these special supplies for emergency use. For example, initial reports on studies started early this spring for OCD by the Army Corps of Engineers and the Navy Bureau of Yards and Docks indicate that in buildings containing public fallout shelter space there is enough water in the normal piping system of the buildings to sustain about 50% of the shelter occupants, and there is already food in the buildings for about 25% of the shelter occupants.

Also, studies conducted by the U.S. Department of Agriculture, under contract to OCD, indicate that, on a nationwide basis, there is enough food in households, retail stores, and local wholesale establishments to sustain people for 43 days, and enough food in local processing plants, cold storage plants, and large wholesale plants to sustain people for 56 days. Now this resource, like the public shelter resource, is not perfectly distributed in relation to where people live. But it is an impressive resource, and we are working on ways to use it effectively in a national emergency.

As you know from the presentation by Jack Wallace of the Canadian Emergency Measures Organization, Canada also is carrying out a survey similar to our National Shelter Survey. We in the Office of Civil Defense are taking a number of steps to expand our survey and increase the national shelter resource.

These actions include an initial installation of portable ventilation kits. Potentially, these kits could provide shelter space for an additional 28,000,000 people.

They include surveys of smaller structures not covered in the original Survey. The potential here is shelter space for an additional 20,000,000 people.

They include the development of a computerized system to evaluate fallout protection in homes with basements. The probable potential: fallout protection for an additional 12,000,000 people.

They include expanded technical assistance to architects and engineers, in government and private construction, on ways to design fallout protection into new structures at little or no additional construction cost.

We will expand civil defense training and education programs. Although we must close our Western and Eastern Training Centers, we will improve both the usage and the quality of instruction at our Staff College in Battle Creek, Michigan. We will also continue the Civil Defense University Extension Training Program, initiated in 1963—a program which has resulted in the training of more than 6,000 shelter managers, and under which nearly 57,000 State and local officials have received orientation in their civil defense emergency responsibilities.

It may interest you to know that, in the last two years alone, nearly 2¼-million persons have taken part in various types of civil defense training and education programs throughout the United States.

We will continue to support the development of State and local Emergency Operating Centers. To date, nearly 2,000 EOCs have been or are being developed by States and localities, about one-third of these with Federal matching funds. Congress has approved funds for the construction of seven other Federal Regional Emergency Operating Centers, in addition to the one at Denton, Texas, and we will move this program forward as rapidly as possible.

Governmental Responsibility

These are just a few examples of actions we will take to expand the civil defense program. There are others, and one of these relates both to the expansion of the program and to the need for increasing the acceptance of civil defense as a fundamental responsibility of government at all levels. I am referring to the Community Shelter Planning program.

As you know, the Office of Civil Defense has financed Community Shelter Planning projects in 57 communities, at least one in every State. This program

(Continued on page 24)

EMERGENCY PLANNING FOR INDUSTRY

Department of Defence Production

The Department of Defence Production, through its Emergency Supply Planning Branch, has published a booklet *Emergency Planning For Industry* for the guidance of business and industrial management in planning against national and other disasters.

The booklet sets out the measures necessary to plan and organize a company's operations against a peacetime disaster or a national emergency, and in its preface notes that it is good business practice for a company to have plans ready to meet an emergency, be it a fire, explosion, or other industrial accident, a natural disaster caused by storm or earthquake or the major catastrophe of a nuclear war.

The first portion of the booklet deals with emergency planning undertaken by government and goes on to propose steps which industry should take to enhance their ability to continue or quickly restore operations under such circumstances. The measures recommended are those concerned primarily with the continuity of management, the protection of personnel, plant and equipment, and the safeguarding of essential records.

The success of a program of emergency preparedness will depend upon senior management initiating it as a matter of long term policy and maintaining an active interest in its direction of the planning, training, and organization involved. This can best be insured by appointing a senior company officer to direct the many tasks involved. A great deal of technical advice is available from a number of sources to assist him in establishing and training the necessary organization.

The officer appointed as emergency coordinator or director will need to enlist the co-operation of heads of various units of the company or plant and the support of employees by an educational program. It is recommended that the coordinator appoint a deputy to ensure continuity to the program and arrange for the nomination of the heads of the various emergency service groups. Under the chairmanship of the co-ordinator these people would form a committee to direct planning, organization and training. One of the major tasks of the committee would be to compile and keep up to date a company manual of emergency plans which would delineate all tasks and responsibilities in case of a disaster.

The organization of emergency services in industry is treated in some detail in the booklet and is based on the extension of services which are normally associated with the peacetime operations of most industrial firms. Where plants are large enough to provide their own emergency services, the organization will generally follow a pattern similar to that shown in the accompanying chart. Companies which are not large enough to support a complete emergency organization may achieve the same results by co-operative planning and mutual aid agreements with other plants in their area.

The booklet points out that there are a variety of training courses which could be of assistance to companies in their industrial continuity programs. Some of these are sponsored by provincial and municipal authorities and others by federal agencies. Such courses are designed to provide instruction for three different categories of personnel; senior management, supervisory staffs and technical staffs. The senior management course is conceptual in nature, the training course for supervisory staff involves a more comprehensive treatment of specific subjects and the third type of course is related to the technical aspects of emergency tasks.

The planning tasks and operational roles of the various components of a typical emergency organization are outlined in the booklet and refer particularly to the requirements of:

Engineering and Maintenance

This team would be responsible for shelter surveys and their subsequent design and construction. An important planning task would be the development of emergency shut-down procedures and the methods to maintain plant equipment during an enforced stoppage of work.

Radiological Monitoring

Members of this unit will likely be found in the engineering or technical staff and must be trained in the use of radio-active fallout detection instruments. Their duties would include the monitoring of radiation levels in shelter areas and determining safe exposure periods outside of the shelters. Another task would be planning and supervision of decontamination procedures for personnel, equipment and buildings.

Fire and Rescue

The operational role of this unit is self-evident but it must also assume some new planning tasks, especially with regard to reducing plant fire hazards which might arise from external situations.

Medical

Medical teams should be formed around existing first aid and health facilities. Planning required of this team would include provision for emergency medical facilities, stockpiling of drugs and supplies for use at a time when health hazards and sanitation problems would be multiplied.

Communications

The foremost task of this group would be to arrange for an internal alarm system since warning sirens may not be heard inside noisy plants. Arrangements should be made to back up the plant telephone and intercommunications systems with other means of communication.

Security Force and Warden Team

The primary duty of the security force is the protection of the plant but may be extended to include other tasks related to the safety of employees such as crowd control, planning of evacuation to shelters or from the plant. These latter duties, however, could be taken over by a specially formed warden unit which would leave the security force free for other duties.

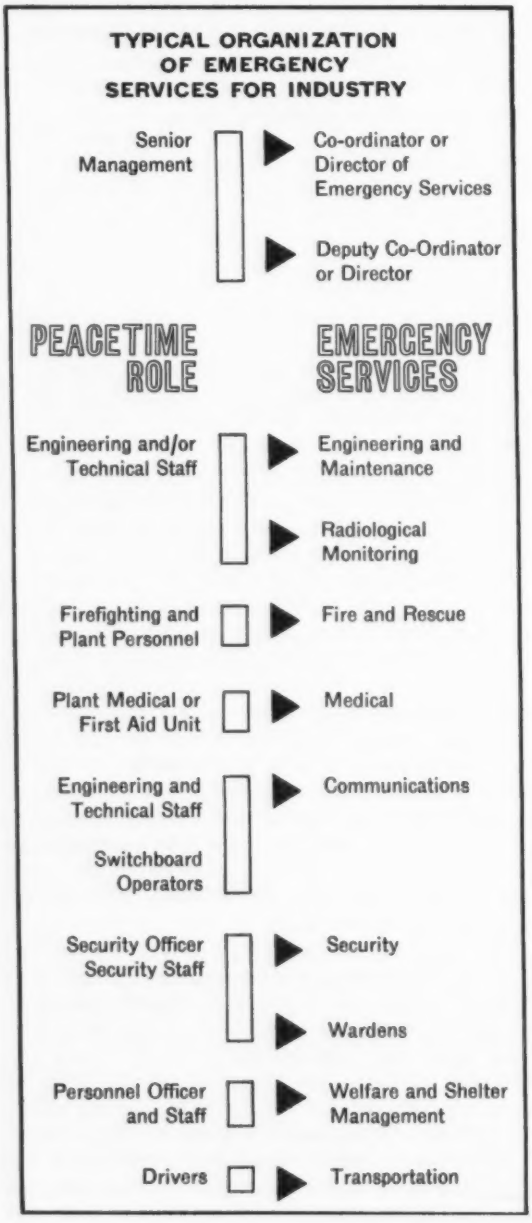
Welfare and Shelter Management

This unit would assume responsibility for living arrangements in the shelter areas including planning for stockpiling of food and clothing, feeding arrangements as well as arrangements for the welfare of employees in such a situation.

Transportation

Vehicles and drivers would be invaluable as part of an emergency team and should be organized into a transportation unit.

The booklet is available in both English and French on request from Regional Offices of the Emergency Supply Planning Branch of the Department of Defence Production or from the Branch's Head Office, Ottawa.▲



(Civil Defence in U.S.—*concluded*)

will be expanded and enlarged because it is fundamental to an efficient system of civil defense.

The purpose of this program is, at once, simple and complex. The purpose is to develop, in every community, practical procedures for making the best possible use of shelter space in the event of attack, for getting this information to each citizen, and preparing each department of local government to support this plan and meet its responsibilities in time of major disaster.

I use the term "major disaster" advisedly. This CSP program is intended to involve and prepare local governments for effective lifesaving action in the event of enemy attack against the United States. But any sensible person can see that if government is prepared for this type of catastrophe, it is also prepared for effective action in time of major peacetime disasters, such as floods, earthquakes, hurricanes, and tornadoes.

Many of us here today have seen effective civil defense actions in major peacetime disasters. And we know that, when the chips are down, there is no substitute for preparation.

Frequently in news accounts of major disasters there are references to "civil defense workers." Who is this person called a "civil defense worker" who suddenly emerges when major disaster strikes? Well, I know who he is, even though he might not recognize himself as such. When a major disaster strikes, this person called a "civil defense worker," whatever type of identification he wears, could be a police officer, a fireman, a truck driver, a sanitation expert, a nurse, a radio announcer —anyone who is working in a concerted effort *under responsible government* direction to cope with the disaster.

This is a "civil defense worker." And this is civil defense. And we are going forward with this program of preparedness under this concept of governmental responsibility.

I want to thank you for inviting me to this conference in your State and mine—for I spent my boyhood in California, and members of my family still reside here. The State of California has a major role in this program of civil defense. We all do—in every State. And we have a job to do. ▲

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The Director General, Editor, Officers and Staff of the Emergency Measures Organization, take this opportunity to wish Digest readers and contributors all good wishes for Christmas and the New Year.